The Fox Project: Advanced Development of Systems Software

R&D Status Report
April 1 to June 30, 1998

School of Computer Science
Carnegie Mellon University
Pittsburgh, PA 15213

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DTIC QUALITY INSPECTED 1

Carnegie Mellon

July 10, 1998

ESC/AXS Harry Koch
ARPA Agent
5 Eglin Street
Building 1704, Room 205
Hanscom AFB, MA   01731-2116

Dear Harry:

RE: Contract F19628-95-C-0050
       "The Fox Project: Advanced Languages for Systems Software"
       #1-52220

Enclosed is the quarterly R&D Status Report covering our research progress during the period April 1 through June 30, 1998. Should you have any questions, please do not hesitate to contact me at 412/268-3853.

Have a wonderful day!

Best regards,

Rosie Battenfelder

/rmb
Enclosures

Copy to: G. Koob, DARPA/ITO
            C. Stephan, ESC/AXK
            DARPA Technical Library
            Office of Naval Research
            Defense Technical Information Center/OCC

            P. Lee, CMU
            R. Harper, CMU
            M. Brendel, CMU
            A. Stoltzfus, CMU

The long-term objectives of the Carnegie Mellon Fox Project are to improve the design and construction of systems software and to further the development of advanced programming language technology. We use principles and techniques from the mathematical foundations of programming languages, including semantics, type theory, and logic, to design and implement systems software, including operating systems, network protocols, and distributed systems. Much of the implementation work is conducted in the Standard ML (SML) language, a modern functional programming language that provides polymorphism, first-class functions, exception handling, garbage collection, a parameterized module system, static typing, and a formal semantics. This Project involves several faculty members and spans a wide range of research areas, from (1) advanced compiler development to (2) language design to (3) software system safety infrastructure.

1   Research Progress

For each of the three areas listed above, we report on the research accomplishments during the second calendar quarter of 1998, and the research objectives for the third quarter of 1998.

1.1   SML Compiler and System Development

Accomplishments (April-June):

- Completed the first successful bootstrap of the TILT compiler for full Standard ML.

- Implemented the very beginnings of a compiler from the modal source language to real machine code (x86).

Objectives (July-September):

- Complete initial implementation of optimization phases for TILT.

- Continue to work on extending the full language ML to include explicit staged-computation constructs.

1.2   Language Design

Accomplishments (April-June):

- Beta release of Twelf 1.2, a complete reimplementation of the logical framework underlying proof-carrying code (PCC), including a complete manual, example suites, and theorem prover.

- Updated the typechecker for the TILT middle intermediate language and began addressing scaling issues.

Objectives (July-September):

- Complete type checker implementation for TILT intermediate language.

- Release Twelf 1.2.

- Finish theory of refinement types with effects.

1.3   Software System Safety Infrastructure

Accomplishments (April-June):

- Completed a preliminary design for a version of PCC for Intel x86 architectures.

- Conducted a survey of techniques for optimizing and compressing PCC proofs.

- Set up an ATM test bed for testing the Fox Net's performance on a high speed network. Ported the Fox Net's runtime and source code to the 110.5 of SML/NJ. Increased the Fox Net's performance over ATM.

Objectives (July-September):

- Complete a final design for the Intel x86 version of PCC.

- Implement several proof optimizations and compression techniques and run experiments to measure their effectiveness.

- Finish Fox Net performance testing and Fox Net journal paper.

2   Noteworthy Publications

- *Generational Stack Collection and Profile-Driven Pretenuring* by Perry Cheng, Peter Lee and Robert Harper. PLDI'98, June, 1998.

- *The Design and Implementation of a Certifying Compiler* by George Necula and Peter Lee. PLDI'98, June, 1998.

- *Run-Time Code Generation and Modal-ML* by Philip Wickline, Peter Lee and Frank Pfenning. PLDI'98, June, 1998.

3   Capital Equipment Purchases

- 3 220-0382 Dell 6400 PII MT Workstations, $15,336.00

4   Key Personnel Changes

- Ken Cline has left the Fox Project. He had been the Staff Research Programmer. He has been replaced by David Swasey.

5   Noteworthy Meetings

- ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'98) (Montreal, Canada, June 17-19, 1998). The Fox Project presented four papers on current and recent research at the conference.

- Upenn SwitchWare project (Philadelphia, PA, April 30 - May 1, 1998). Peter Lee was an invited guest to the retreat and gave a talk on the possible uses of PCC in Active Networks, and interacted with the entire SwitchWare group.

- Symposium on Logic in Computer Science (Indianapolis, IN, June 21-24, 1998). George Necula presented a paper entitled "Efficient Representation and Validation of Proofs".

6   Administrative Data

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